

Technical Memorandum 2 Population, Flow and Loads

Draft
September 2004

Only sections or other elements of Technical Memorandum (TM) 2 revised for the Final EIS are included here. These changed sections combined with the unchanged sections of Technical Memorandum 2 in the Draft EIS constitute Technical Memorandum 2 of the Final EIS. Please see the introduction to the “Changes Made in the Draft EIS in Response to Comments” section for a full explanation.

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4.3 Water Conservation

It is King County's desire to reduce wastewater production rates in all of its service districts. Furthermore, RCW 90.48.495 requires that sewer plans include analysis of the potential effects of water conservation programs on wastewater flow.

Although the Carnation WWTF will be a new facility, existing housing and commercial establishments in Carnation will include a variety of older, conventional fixtures. It is possible that, through replacement of conventional fixtures by water-conserving fixtures, a significant further reduction in unit wastewater could result. This would not be expected to affect wastewater loads, except that concentrations would be increased.

The City of San Francisco conducted a study on the savings resulting from 1,024 multi-family conservation audits in 1994. This study found that for smaller accounts (25 hundred cubic feet (ccf) per month) consumption was reduced 6-24 percent. For larger accounts, however, (500 ccf or more per month) water consumption actually increased by 4-13 percent¹. New York City's Toilet Rebate Program replaced over 1.1 million old high-water-consuming toilets (5 gallons per flush) with 1.6 gallon per flush units². This survey reviewed customer satisfaction with the program, but did not estimate the overall savings in wastewater production. The City of Barrie, Ontario pursued a program of replacement of fixtures with ultra low flow 6-liter toilets and low flow showerheads and faucet aerators³. They concluded that replacement of two thirds of the City's inefficient toilets could defer the need for water treatment plant expansion by 3 to 5 years.

Another study conducted in Australia found a 30 percent savings in water consumption because of energy and water efficient design of a medium density town house development⁴. The City of Albuquerque, New Mexico, has set a goal of reduction in water consumption by 30 percent through use of water saving fixtures and low water consumption landscaping⁵. Landscaping savings would not result in a reduction in wastewater production, however.

For Carnation, an analysis of water conservation was conducted by King County staff. A series of potential water conservation goals were established as follows:

- Conventional Design
- Code Reduction after 2000
- Bring Existing Residents to Code

¹ Knox, Kimberley M., "Savings from San Francisco Water Department's Multifamily Conservation Audit Program", AWWA, 1996.

² New York City Department of Environmental Protection, Bureau of Customer and Conservation Services, "Evaluation of New York City's Toilet Rebate Program: Customer Satisfaction Survey: Final Report", 1996.

³ Gates, Chris, Ramsay, Judith, and Brown, Ken, "An Evaluation of the Effectiveness of a Municipal Toilet Replacement Program," in 1996 *Annual Conference Proceedings, the American Water Works Association, Water Resources*, June 23-27, 1996.

⁴ Cumming, H., "Water Consumption Down 30% at Stringybank Grove", AWWA, January/February 1996.

⁵ AWWA, "How to Save Water at Home: A Step-By-Step Manual for the Do-It-Yourselfer, 1996.

- Residential Conservation Retrofit
- Full Conservation Retrofit

Conventional design represents the unit rates presented in Table 2.3. The second category assumes that future residential connections will use low-water-consuming toilets and contribute a percapita rate of 54 gpcd, rather than the 70-gpcd rate from Table 2.3. This is not really a conservation measure, but rather an assumption that existing code requirements will be enforced in the future with the effect that new homes would contribute 54 gpcd, rather than 70 gpcd. The third scenario assumes that in addition to new homes contributing at 54 gpcd, existing homes in Carnation would be retrofitted with low-water-consuming fixtures to reduce the overall unit rate to 54 gpcd. The fourth scenario assumes that in addition to low-water-consuming toilets, low-water-consuming washing machines and dishwashers would be installed in all residential units as part of a comprehensive program of water conservation. In the last scenario, it is assumed that full retrofit for low-water-consuming fixtures would also be pursued in commercial establishments and schools. Table 2.7 presents the assumed unit rates for wastewater flow production for each of the five water conservation scenarios. Estimated flow rates are presented in Table 2.8. The table shows the estimated flow savings from each of the four conservation scenarios.

To explore impacts of conservation, estimated costs for implementation of conservation programs corresponding to the four conservation scenarios were compared to the capital and operating cost savings that would be realized in construction and operation of new collection and treatment facilities for Carnation, if the assumptions stated above for each scenario come true. Cost estimates for implementation of the conservation strategies were provided by King County. Cost estimates for treatment plant construction and operation were based on Carollo cost models for a membrane bioreactor plant assuming the same level of associated facilities as assumed in the HDR report.⁶ Estimated costs for the conservation programs are presented in Table 2.9. The conservation flows and costs presented are rough estimates and require refining. As the sewer project moves forward these figures will be revised and water conservation approaches reconsidered. For further detail on City of Carnation water conservation policy, please see the 2004 City of Carnation *Comprehensive Sewer Plan*.

⁶. HDR, Inc., King County Conveyance System Improvement Project, King County Wastewater Service to the City of Carnation, Memorandum, 2001

**Table 2.7 Unit Water Consumption Rates for Water Conservation Scenarios
Carnation Wastewater Treatment Facility
King County Department of Natural Resources and Parks**

Parameter	Conventional Design	Code Reduction after 2000	Bring Existing Residents to Code	Residential Retrofit	Full Retrofit
Unit Flow Rates					
Residential, gpcd	70	70 / 54	54	41	41
Commercial, gpcd	30	30	30	30	26
Middle/High Schools, gpcd	16	16	16	16	8
Elementary Schools, gpcd	10	10	10	10	5
Park, gal per site per day	100	100	100	100	100

**Table 2.8 Projected Average Annual Flow Rates for Water Conservation Scenarios
Carnation Wastewater Treatment Facility
King County Department of Natural Resources and Parks**

Parameter	Conventional Design	Code Reduction after 2000	Bring Existing Residents to Code	Residential Retrofit	Full Retrofit
Total Average Annual Flow, mgd					
Startup in 2008	0.18	0.17	0.15	0.12	0.11
Full Sewer in 2013	0.27	0.25	0.23	0.19	0.17
Design Flow at 2027	0.35	0.32	0.29	0.24	0.22
Saturation in 2050	0.39	0.35	0.33	0.28	0.25
Conservation Flow Savings (2027)	0.00	0.03	0.06	0.11	0.14

**Table 2.9 Projected Average Annual Flow Rates for Water Conservation Scenarios
Carnation Wastewater Treatment Facility
King County Department of Natural Resources and Parks**

Costs	Conventional Design	Code Reduction after 2000	Bring Existing Residents to Code	Residential Retrofit	Full Retrofit
Construction Cost, \$					
Treatment Plant	\$6,100,000	\$5,870,000	\$5,700,000	\$5,360,000	\$5,150,000
Conservation Program	\$0	\$0	\$540,000	\$2,257,000	\$2,660,000
Capital Costs, \$					
Treatment Plant	\$10,700,000	\$10,300,000	\$10,000,000	\$9,400,000	\$9,100,000
Conservation Program	\$0	\$0	\$703,000	\$2,934,000	\$3,459,000
Operations Cost Present Worth, \$	\$7,119,000	\$6,740,000	\$6,464,000	\$5,921,000	\$5,590,000
Total Present Worth Cost, \$	\$17,819,000	\$17,040,000	\$17,167,000	\$18,255,000	\$18,149,000
Cost Savings, \$					
Collection System Capital Cost	\$0	\$0	\$0	\$359,000	\$359,000
Treatment Plant Capital Cost	\$0	\$400,000	\$700,000	\$1,300,000	\$1,600,000
Treatment Plant Operations and Maintenance	\$0	\$379,000	\$655,000	\$1,198,000	\$1,529,000
Total	\$0	\$779,000	\$1,355,000	\$2,857,000	\$3,488,000
Conservation Savings, \$	\$0	\$779,000	\$652,000	(\$77,000)	\$29,000
Cost Basis:					
January 2000 Cost Index, Flow estimates based on 2003 Carnation Comprehensive Sewer Plan					
River Outfall Allowance of \$92,000, no anaerobic tanks for P removal or odor control					
Limited administration building (1500 sf), chemical tanks outdoors (heat taped)					
Estimated construction costs for treatment based on Carollo Carnation WWTF MBR cost model, O&M Costs based on Carollo model					
Assumptions about costs and facilities comparable to HDR Memorandum, September 2001					
Collection system cost savings based on Table 4.8 Carnation <i>Comprehensive Sewer Plan</i> by Roth Hill					
Capital cost markup for treatment plant of 176% times estimated construction cost based on HDR Memorandum					
Conservation capital and construction costs based on Table 4.8 Carnation <i>Comprehensive Sewer Plan</i> by Roth Hill					